

BACTERIAL WATER QUALITY OF JACK LAKE,
COUNTY OF PETERBOROUGH

by

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Abstract

During the July and September 1970 bacterial water quality surveys, the bacterial levels were below the water quality criteria for total body contact recreation with geometric mean levels as follows:

<u>Survey:</u>	<u>Total Coliform (TC)/100 ml.</u>	<u>Fecal Coliform (FC)/100 ml.</u>
July 26-29, 1970	10	1
September 8-11, 1970	26	1

Some natural station-to-station variation was present but was insufficient to warrant a critical remark.

Introduction

As part of the Recreational Lakes Program in 1970, two intensive bacteriological surveys were carried out on Jack Lake in the County of Peterborough. Jack Lake can be divided into two basins, a northern and a southern one. The lake has an irregular shoreline with many small islands. Water flows in a north to south direction from many small creeks to the lake and out through Jack Creek. Most of the shoreline is developed with cottages and there are no towns on the lake.

Methods

During the two surveys, July 26 to 29, 1970 and September 8 to 11, 1970, daily bacteriological samples were taken for four days at forty-four surface stations and three depth stations at stations 18, 32 and 36. Surface stations were sampled within one meter of the water's surface with sterile polypropylene bottles obtained from the Public Health Laboratories. Depth stations were sampled using sterile 237 ml. air syringes and a modified "piggy-back" sampler. After taken, samples were stored on ice until delivery to the Department of Public Health Laboratory in Peterborough. Samples were analyzed for total coliform (TC) and fecal coliform (FC) within 24 hours of sampling by the staff of the Public Health Laboratory. The analysis for total coliform and fecal coliform was carried out using the membrane filtration procedure on m-Endo broth plus agar and m-FC agar, respectively.

The data from the analyses were then evaluated on the basis of the logarithmic transformation of the individual counts and the geometric mean.

Geometric means for each station and parameter were calculated, utilizing the daily counts as replicates of the station and parameter. In order to test the differences between stations for each parameter, the data was entered into a one-way analysis of variance or F-test computer program. This computer program also tested the normality of the transformed data and the homogeneity of the variances. If the calculated F ratio was less than the critical F from statistical tables, no significant differences existed between the stations. The stations could be summarized as one group.

However, if the calculated F was greater than the critical F, the station or stations, which were significantly different, were determined by use of a multiple t-test which tested each station against every other station. The data from significantly different stations were withdrawn from the original grouping. All new resultant groupings were rerun through the computer program. This procedure was repeated until all groupings showed no significant differences. The groupings in the July survey, survey A, were then tested for significance against the groupings in the September survey, survey B, by using a t-test on the overall group means. This procedure tested the change in bacterial parameters with time.

All means were simultaneously compared with the water quality criteria for total body contact recreational use (OWRC, June, 1970).

Results & Discussions

Summaries of the analysis of variance groupings are presented in Tables I and III. The summaries of the tests of significance between

surveys are presented in Tables II and IV. Figures 1 and 2 presents the station locations and the geographic distribution of the bacterial levels.

All geometric mean bacterial levels were well below the water quality criteria for total body contact recreation.

(1000 TC/100 ml. and 100 FC/100 ml)

Some differences between bacterial levels at particular stations did occur in both surveys. However these differences were of sufficiently low magnitude as to be accounted for by a change in the natural condition at these stations from the normal condition at the other stations on the lake. Thus, although these differences were statistically significant, they were not sufficiently significant to interpret the cause of the difference or to warrant any critical remarks concerning the water quality.

During the July survey, the bacterial levels at most stations were summarized as 10 TC/100 ml and 1 FC/100 ml. During the September survey, the TC level increased significantly to 26 /100 ml while the FC level remained unchanged at 1 /100 ml.

Therefore Jack Lake possessed bacterial levels during the two 1970 surveys below the water quality criteria.

Reference

Ontario Water Resources Commission, 1970, Guide lines and Criteria for Water Quality Management in Ontario.

TABLE I

Summary of the Analysis of Variance Grouping of Stations

Jack Lake, 1970

Parameter: Total Coliform (TC)/100 ml

Survey A) July 26 - 29, 1970 B) September 7-10, 1970

Group All Stations All Stations

F	1.63	df	46, 141	1.86	df	46, 141
F(5%)			1.47			1.47
			SD			SD

Group 1) All stations except 1) All stations except
 5, 32D, 36D & 42 32D & 36D

F	1.16	df	42, 129	1.12	df	44, 135
F(5%)			1.49			1.48
			NSD			NSD
log GM			1.0095			1.4216
S.E.			0.0440			0.0406
N			172.			180.
GM			10.2			26.4

Group 2) Station 5 2) Station 32D

log GM		1.8993	0.0753
S.E.		0.2443	0.0753
N		4.	4.
GM		79.3	1.2

Group 3) Station 32D 3) Station 36D

log GM		0.5951	0.5242
S.E.		0.5951	0.1747
N		4.	4.
GM		3.9	3.3

Group 4) Station 36D

log GM		0.1747
S.E.		0.1747
N		4.
GM		1.5

Group 5) Station 42

log GM		2.0365
S.E.		0.1231
N		4.
GM		108.8

TABLE II

Summary of Tests of Significance between Analysis of Variance Groups

Parameter: Total Coliform (TC)/100 ml.

		Survey B		
Group		1	2	3
	1	6.89 SD** df 35	-	-
Survey A	2	1.74 NSD df 182	-	-
	3	-	0.87 NSD df 6	-
	4	-	-	1.41 NSD df 6
	5	2.25 SD df 182	-	-

NSD = no significant difference at the .05 level

SD = significant difference at the .05 level

SD** = significant difference at the .001 level

TABLE III

Summary of the Analysis of Variance Grouping of Stations
Jack Lake, 1970

Parameter: Fecal Coliform (FC)/100 ml.

Survey	A) <u>July 26 - 29, 1970</u>	B) <u>September 7 - 10, 1970</u>
Group	All stations	
F	2.56 df 46, 141	
F(5%)	1.47	SD
Group	1) All stations except 3, 5, & 38	1) All stations
F	1.30 df 43, 132	1.33 df 46, 141
F(5%)	1.49	1.47
	NSD	NSD
log GM	0.1381	0.1373
S.E.	0.0202	0.0207
N	176.	188.
GM	1.4	1.4
Group	2) Station 3	
log GM	0.6628	
S.E.	0.2709	
N	4.	
GM	4.6	
Group	3) Station 5	
log GM	1.1974	
S.E.	0.3039	
N	4.	
GM	15.8	
Group	4) Station 38	
log GM	0.5396	
S.E.	0.1846	
N	4.	
GM	3.5	

TABLE IV

Summary of Tests of Significance between Analysis of Variance Groups

Parameter: Fecal Coliform (FC)/100 ml

		Survey B
Survey		Group
A	1	1
	1	0.03 NSD df 362
	2	3.59 SD** df 190
	3	7.19 SD** df 190
	4	2.79 SD* df 190

NSD = no significant difference at the .05 level
SD* = significant difference at the .01 level
SD** = " " " " " .001 level

APPENDIX A - Explanation of Terms in Tables

F the calculated analysis of variance statistic or F ratio

df degrees of freedom of the F ratio for "between group" and "within group" variation

F(5%) the critical F ratio from a statistics table

If the calculated F is greater than the F(5%) a significant difference (SD) occurred between the groups in the analysis. If F is less than F(5%), no significant difference (NSD) occurred.

log GM the logarithm (base 10) of geometric mean for all groups in the analysis of variance when NSD occurred

S.E. the standard error of the log GM where

$$S.E. = \frac{s}{\sqrt{N}} \text{ and } s = \text{standard deviation}$$

N the number of values in the mean

GM the geometric mean of the bacterial level

t the calculated test of significance on t-tests to determine the between survey difference

If t for the number of degrees of freedom (df) shown is greater than the critical t value, a significant difference (SD) occurs

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